Beware of Superbugs in a Post-COVID World

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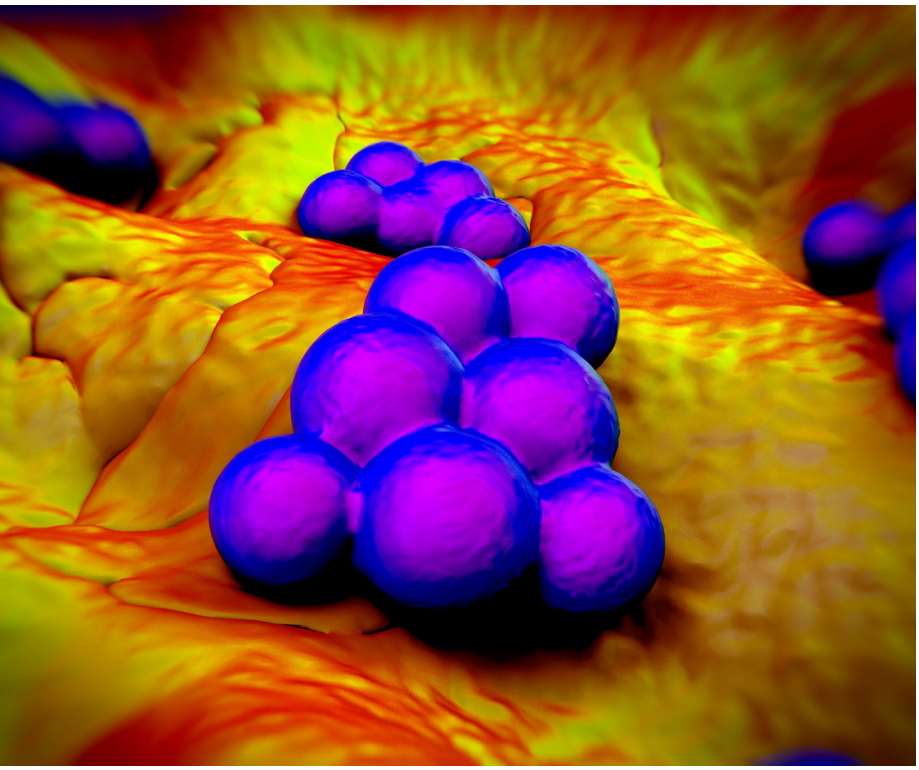

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***Editor's note**: Having completed the inaugural Water Quality Matters column series focusing on the theme "Hot Topics in Water Quality," initiated in the April 2019 issue of* Journal AWWA, *the AWWA Water Quality and Technology Division's committees extend the conversation in this recurring column by expounding on a common question, "What keeps you up at night?"*

The myriad ways in which COVID-19 has affected our lives will be studied for years to come, as the pandemic has had devastating impacts on public health and the economy, and even the water industry has faced increased safety requirements and potential revenue losses. The global response to the pandemic has meant a widespread upsurge in use of disinfectants and cleaning products as well as antibiotics, which can contribute to an increase in antimicrobial resistance (AMR). Disinfectant and antibiotic concentrations in wastewater are likely to increase, which could lead to more selective pressure in wastewater for antimicrobial-resistant bacteria (ARB), thereby contributing to AMR. This cascading effect, coupled with a potential decrease in AMR surveillance from the intensified focus on the pandemic response, will add to AMR-related concerns as outlined by public health organizations such as the World Health Organization, United Nations, and US Centers for Disease Control and Prevention.

A Call for Global Action

The colloquial term *superbugs* often refers to microbes with enhanced abilities to cause morbidity and mortality in humans; these microbes can have multiple mutations that endow them with high levels of resistance to antibiotics currently in use. With therapeutic options for these microbes reduced, it becomes more difficult to protect public health. Also, horizontal transfer of drug resistance genes can potentially spread antimicrobial resistance genes (ARGs) between different bacterial species, further complicating this situation. The health and economic impacts from the emergence and spread of multidrug-resistant bacteria have been documented for decades, and several countries have recognized the need for a concerted effort to approach AMR mitigation through increased global surveillance and research.

What this means is that the water industry will be under added pressure to understand the effects of biocides and disinfectants released into water sources more than in the past. For example, the COVID-19 pandemic hasn't prompted a change in drinking water or wastewater treatment processes because SARS-CoV-2 (the causative agent of COVID-19) is susceptible to commonly used drinking water and wastewater treatment processes. The current pandemic may exacerbate AMR, so it's important for

global public health organizations, government agencies, academia, and the water industry to ramp up efforts to determine the effect of selective pressure exerted by antibiotics and disinfectants in wastewater on the formation of drug-resistant bacteria. Direct potable reuse applications may also need to address public concerns with AMR because of their proximal connection to wastewater.

No surrogate organisms can gauge treatment effectiveness for ARB through wastewater treatment trains. However, techniques to identify and monitor ARB and ARGs are rapidly evolving along with advanced water treatment options for removing these contaminants.

Wastewater-Based Epidemiology

The water industry can use wastewater-based epidemiology (WBE) to better understand the impact of ARB. This tool correlates findings of wastewater surveillance to public health data in a community. WBE has been used for decades to study vaccine effectiveness for infectious diseases such as polio or to track the extent of the opioid epidemic. WBE doesn't replace clinical surveillance but instead serves as another tool to help public health officials track situations and develop their responses.

A Benefit for Utilities and Health Officials

The COVID-19 pandemic highlighted the importance of WBE and created wider awareness of its use with utilities. In early 2020, when COVID-19 began to spread at an alarming rate worldwide, many researchers collaborated with utilities and mobilized WBE to help health officials follow the spread of the virus and make mitigation decisions.

Preliminary data suggest that wastewater surveillance of SARS-CoV-2 could serve as a leading indicator of COVID-19 burden in communities where testing is scarce or unavailable or provide supporting information in conjunction with other tests. This can allow public health officials crucial time to ramp up additional testing, increase public health communication, and prepare for hospital capacity in community hotspots. WBE has resulted in several fruitful collaborations among local governments, states, universities, utilities, and health officials that can remain the foundation for application to AMR issues.

Participation in such collaborative efforts has helped showcase utilities' role in protecting public health and has helped integrate this research area into the water industry. Collaboration has paved the way for establishing national wastewater surveillance systems that, if AMR surveillance is included, would draw attention to how to modify the widespread use (and abuse) of antibiotics. WBE could also inform utilities on optimal treatment processes according to specific local conditions.

Further Research Needed

WBE has the potential to drive further research on AMR issues and help curb the spread of ARB. However, research gaps remain:

- Understanding horizontal gene transfer in wastewater
- Understanding the effectiveness of various wastewater treatments against ARGs (especially to identify potential hotspots in sewer networks)
- Understanding the role of ARGs in drinking water and recreational water in causing drug resistance in the human gut
- Knowing how to develop risk assessments of human exposure to AMR in various situations such as water reuse or recreational water exposure

To this end, a subsampling effort in the sewersheds across various industries (e.g., hospitals and pharmaceutical manufacturers) could increase the effectiveness and decrease the cost of surveillance.

A Committee's Mission

The mission of AWWA's Organisms in Water Committee, which is part of the association's Water Quality and Technology Division, is to synthesize and communicate the current science on organisms in water, including pathogens, toxin producers, invasive species, indicators, and nuisance organisms. As part of this mission, the committee has highlighted antimicrobial resistance in *Journal AWWA* articles and in workshops and sessions at AWWA's Water Quality Technology Conference.

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